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FEDERAL GUIDELINES

EQUITABLE RECOVERY OF INDUSTRIAL WASTE TREATMENT COSTS IN MUNICIPAL SYSTEMS

ENVIRONMENTAL PROTECTION AGENCY

OCTOBER 1971

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Federal Guidelines

Equitable Recovery of Industrial Waste Treatment Costs

in Municipal Systems

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Federal Guidelines

Equitable Recovery of Industrial Waste Treatment Costs

in Municipal Systems

October 1971

U. S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF WATER PROGRAMS
WASHINGTON, D. C. 20242

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FOREWORD

These Guidelines are issued to supplement and interpret Regulation 18 CFR 601.34, as published in the FEDERAL REGISTER on July 2, 1970.

The objective of the Regulation is to ensure that the industrial share of the allocable treatment costs, ie., the local capital, operation and maintenance, and debt service charges, to be recovered is proportionate to the costs of treating industrial wastes. The most important element in the Guidelines is equitable cost recovery of the costs of treating industrial wastes in municipal systems.

These Guidelines are intended to assist local and State agencies in administering the provisions of Regulation 18 CFR 601.34.

Many have contributed to the development of these Guidelines. We particularly wish to thank the Ad Hoc Technical Advisory Group to the Division of Facilities Construction and Operation, composed of representatives of the American Society of Civil Engineers, the Association of Metropolitan Sewerage Agencies, the Association of State and Interstate Water Pollution Control Administrators, the Conference of State Sanitary Engineers, the Great Lakes-Upper Mississippi Board of Sanitary Engineers, the U.S. Council of Consulting Engineers, the Water and Wastewater Equipment Manufacturers' Association, and the Water Pollution Control Federation, for their advice and counsel in reviewing the Guidelines.

Eugene T. Jensen
Deputy Assistant Administrator for Water
Office of Water Programs
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FEDERAL GUIDELINES FOR EQUITABLE RECOVERY OF INDUSTRIAL WASTE TREATMENT COSTS IN MUNICIPAL SYSTEMS

Purpose

These Guidelines are issued to supplement and interpret Regulation 18 CFR 601.34 (see Appendix), and nothing herein should be construed to be in variance with the cited regulations. In addition, the Guidelines do not supersede or replace conformance with other Federal regulations to the awarding of a grant. The provisions of the regulations and these Guidelines are applicable to all PL 84-660 (as amended) grant applications for municipal facilities treating effluent[1] from manufacturing activities (those activities as identified in the Standard Industrial Classification Manual, Bureau of the Budget, 1967, as amended and supplemented, under the category "Division D - Manufacturing")[2] and such other wastes[3] as the Administrator deems appropriate for consideration.

The Guidelines are designed to clarify the general provisions of the applicable regulations. Emphasis is on the scope of the provisions and criteria of acceptable compliance. The Guidelines are intended to specify the minimum acceptable revenue to be derived from industry[4] for its share of the facility costs. Cost-recovery formulas which result in amounts collected from industry greater than the attributable costs of treating industrial wastes will not be in conflict with the regulations.

The emphasis throughout is on the necessity for use of average cost pricing for industrial (as defined) users and all other users as distinct classes. Average cost pricing is that technique which allocates total system costs to attributable classes of users by establishing a uniform price per identifiable unit of discharge.[5] Any significant deviation from average cost

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1. The effluent from industrial waste contributors is the influent to the municipal treatment works.
2. Questions relating to included activities may be referred to regional EPA offices for determinations where definitional problems arise. The SIC Manual is available at the U.S. Government Printing Office or the U.S. Department of Commerce.
3. Possible examples are wastes high in concentrations of ammonia, phosphorus, and toxic pollutants.
4. It is here emphasized that the regulations of cost recovery are applied to industry as a class rather than to individual industries. In other words, some industries may be paying more or less than their appropriate share based on contributory costs; if, however, the total sums collected from industries meet the requirement for minimum recovery of attributable costs, then the cost-recovery system is equitable under 18 CFR 601.34.
5. See example #3 P.6, which demonstrates this technique.

pricing which results in industrial payments less than the costs attributable to the treatment of industrial wastes will be construed as being in conflict with the requirements of the regulations. Although EPA will approve any system that satisfies the intent of the regulations, the Guidelines will serve to ease the determination of compliance with the equitable cost-recovery requirement.

The primary Agency interest with respect to the intent of the regulation is:

1. to implement the Agency's basic principle of imposing the cost of waste treatment directly upon the source of pollution.

2. to encourage the use of user charges based upon volume, loading, and character of the wastes.

3. to promote equity in terms of improved knowledge and acceptance by the system's users of the necessity of paying for waste abatement.

4. to promote self-sufficiency in the operation of the treatment system.

In order for EPA to determine compliance with an equitable cost recovery system the applicant must furnish complete information on new facilities and on any existing facilities and proposed expansion or modification thereof, including:

1. general information about manufacturing establishments located and served (or to be served) by the city,

2. approximate flow, loading, and character of waste from industry, as defined, and from all other sources (i.e., the hydraulic volume and the amounts of BOD, COD, suspended solids, and such other wastes affecting the operation of the facilities),

3. treatment works design capacity, in terms of hydraulic flow and loadings,

4. proportion of total excess capacity[6] reserved for industrial users' wastes,

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6. The unused capacity over and above peak requirements of the current loading.

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5. condition of financing for capital improvements including amount and amortization schedule,

6. conditions of financing for fixed charges,

7. conditions for financing and the amount of operation and maintenance charges including special costs created by industrial wastes,

8. source of the revenues to be collected by class of user,

9. method of collection of revenues, and

10. provisions in the cost-recovery system which will take into account significant variations in waste treatment costs associated with volume and/or loading requirements that change over time.

Allocable Costs

The provisions of the regulation are applicable to the total costs (project costs exclusive of grants that do not have to be repaid) incurred by the applicant in construction, funding, and operation and maintenance of its waste treatment works (i.e., all "out of pocket" treatment costs borne by the applicant). Treatment works include the various devices used in the treatment of sewage or industrial wastes of a liquid nature, including the necessary intercepting sewers, outfall sewers, pumping, power, and other equipment, and their appurtenances, and includes any extensions, improvements, remodeling, additions, and alterations thereof (as defined in FWPC Act PL 84-660 as amended).

In cases where State or Federal grants involve no provisions for reimbursement, these funds are not construed as being allocable costs incurred by the applicant and, therefore, they need not be included as part of the total costs borne by the latter.

A. Capital Costs

Examples A, A', and B in the appendix denote the basic procedure of determining allocable capital costs that must be shared by the applicant and participant industries (in example B, the allocable capital costs are reduced by the amount of the non-reimbursable State grant). Ineligible costs, comprised of land, site acquisition, industrial pre-treatment, and collection sewer costs must be subtracted in order to determine grant funds;[7] these costs, however, may be added back at the discretion of the applicant.

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7. Site preparation, however, is an eligible cost.

Total capital costs included in the formulations are those of the design facilities which frequently include excess capacity. Reducing the cost-recovery system base by that portion attributable to excess capacity is an acceptable practice in that excess capacity has benefits which relate to the community as a whole rather than to existing users only (see example c). If, on the other hand, it is evident that a portion of the excess capacity is assignable to a particular industry or industries then it is necessary to include that portion of capital costs in the total to be allocated under the cost-recovery system. As utilized capacity approaches the design capacity (i.e., as flow increases) the cost-recovery system should reflect the shifting distribution of costs and charges between classes of users.

B. Operation and Maintenance Costs

These costs are determined as they accrue, by they must be estimated to comply with the regulations. The annual operation and maintenance costs for a given year can be estimated with little variation from the costs of the previous year. This would be necessary in order to set the basis for each year's charge. All operation and maintenance costs, of course, must be allocated between the applicant and contributing industries.

Recovery Systems Criteria

A. Basis of Cost Allocation

The intent of the regulation with respect to the basis for distributing costs between the applicant and contributing industries is focused upon volume, loading, the character of the wastes, and any other unusual factors. This means simply that the total annual waste treatment costs should be allocated to industry for recovery in proportion to the industrial contribution to the total waste volume and/or loading of the treatment works. Cyclical operations necessitate that higher costs associated with having reserve capacity available through a portion of the year be assigned to the industry (or industries) whose operations create the need for the peaking capacity (therefore, the industrial users should be charged for total capacity needed for their operations). If two or more industrial users can be serviced with peak flows occurring at different times, then special considerations can be given in this situation.

The volume of influent[8] is usually expressed in standard units of flow. Loading or concentration of influent may be expressed in several units of measurement. Pounds of solids and pounds of BOD are customary and acceptable expressions of loading; average daily utilization at cyclical peaks is the acceptable determinant of rates.

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8. The effluent from the industrial waste contributors is the influent to the municipal treatment works.

Although any practicable degree of refinement that enhances equity is encouraged by the intent of the regulations, EPA will approve any rate method that expresses a reasonable measure of flow and loading and assigns attributable costs accordingly.

B. Methods of Allocating Costs

Once the costs to be distributed between the applicant and contributing industries have been adequately estimated or determined, these costs may be distributed or allocated by several acceptable methods. Any allocation method which results in a distribution reasonably in proportion to volume, loading, and/or character of wastes will be acceptable. All allocation methods based on volume or concentration of industrial effluent imply technical knowledge of the extent to which component costs are attributable to the components of volume and loading. This technical knowledge will vary considerably by components and is not generally a precise determination for any component of total project costs. Three commonly used methods of cost allocation based on volume and loading are discussed and illustrated as follows:

1. Capital costs allocated by volume; operation and maintenance costs allocated by loading

   This is perhaps the most simple method that is used to distribute costs roughly in proportion to volume and loading. The effectiveness of this method is directly related to its simplicity. Obviously, capital costs, particularly construction costs, are not directly proportional to volume, nor are O&M costs directly proportional to the quality of flow. However, for conventional facilities designed for ordinary conditions, results of this method are reasonably equitable and often will not vary widely from allocation results of more sophisticated methods.

   In essence this method is summarized as follows: If industrial users contribute 10 percent of the utilized volume of the proposed facility, industry is allocated 10 percent of the allocable capital costs. If industrial users contribute 20 percent of the total loading of the proposed facility, then industry is allocated 20 percent of the O&M costs.

2. Component costs allocated by either volume or loading

   This method distributes allocable costs of facility components on the basis of the parameter to which

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the costs are primarily attributable. For instance, both the capital costs and the O&M costs of pumps are allocated on the basis of the percentage distribution of volume or flow. Both the capital costs and O&M costs of digesters may be allocated on the basis of BOD loading (or total settleable solids).

Many variations and modifications of this general procedure will give reasonably equitable results. This method requires considerable computation because allocable costs must be computed by constituent components. A problem with this method of allocation is that there are components of both capital costs and O&M costs which are not directly associated with either volume or loading. Furthermore, some of these component costs are not easily or properly attributable to any particular combination of volume and loading. Capital cost components of this nature are land costs, site development, control buildings, and capitalized reserve. Some O&M components, such as supervisory costs present similar problems. Under this method of cost allocation, it is suggested that cost components of this nature be allocated on the basis of the average percentage allocation of all other costs.[9]

3. Quantity or quality formulas based on total cost or average unit costs

This method of cost allocation or derivation of industrial charge is computed by several forms of the generalized formula:

$$Ci = v_o Vi + b_o Bi + s_o Si$$

Note: the principle applies equally well with additional terms (e.g., chlorine feed rates) or less terms (e.g., $v_o Vi$ only).

Where Ci = charge to industrial users, $/yr.

v_o = average unit cost of transport and treatment chargeable to volume, $/gal.

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9. An explication of the foregoing is presented in an article by George J. Schroepfer which is reprinted and included as an attachment to these Guidelines.

b_o = average unit cost of treatment, chargeable to BOD, $/lb.

s_o = average unit cost of treatment (including sludge treatment) chargeable to SS, $/lb.

Vi = volume of waste water from industrial users, gal/yr.

Bi = weight of BOD from industrial users, lb/yr.

Si = weight of SS from industrial users, lb/yr.

The terms b_o and s_o above may include charges (surcharges) for concentrated wastes above an established minimum based on normal load criteria.

Inasmuch as it is an objective of the Guidelines to encourage the initiation and use of user charges, this general method of allocation is both preferable and acceptable.

C. Payment Procedures

1. Amortization and debt service charges

Unless industrial users make lump sum payments for their portion of the system's costs, all allocable capital costs are represented in the debt to be funded, and debt service charges must reflect the total amount financed by debt obligation including interest.

2. Evaluation period

The period of the bond issue is the basis for computation of the cost allocation and cost sharing proposals.

Allocable capital costs are ordinarily funded, often entirely, by debt obligation in the form of revenue bonds. Such bonds are frequently issued in series form or for terms shorter than the life of the project. This would result in annual debt service charges in excess of the annual amortization costs (over the expected life of the facility).

D. Recovery Systems and Sources of Revenue

In accord with a primary intent of the regulations, an average unit cost user—charge system which distributes the cost of waste treatment equitably among contributors of wastes to be treated (and therefore makes as direct as possible the incidence and impact of these costs) is, by definition, an equitable cost recovery scheme. This notwithstanding, acceptable recovery schemes will not be limited to user charges[10] or surcharge schedules. Recovery schemes which reasonably meet the general criterion (equitable distribution of treatment costs between classes of users) and are within the context of State and local laws and institutions will be acceptable to EPA.

E. Situations Where Inequities May Arise

1. Property taxes

Tax advantages to industrial users which result in their paying less than their share for treatment costs will not be equitable. Consequently, in those cases where some portion of the treatment costs are recovered from property taxes, the applicant must show that the industrial share to be recovered is in fact proportionate to the costs of treating industrial wastes.

2. Quantity discounts

Quantity discounts to industries with large volumes of wastewater will not be acceptable unless the applicant shows that the industrial share to be recovered is proportionate to the costs of treating industrial wastes. Economies of scale are an integral feature of large volume systems and, therefore, assignment of savings at the margin to large users is incompatible with the general principle of distinguishing not among individual discharges, but between industry and other classes of users.

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10. Revenues to recoup allocable costs are usually in the form of property taxes (or other general municipal revenues) or user charges. The portion of volume attributable to excess capacity for future use should ideally be charged to property to the extent that the entire community benefits. As utilized volume approaches the design capacity, and loading requirements concomitantly increase the operation and maintenance costs, the portion of recoverable costs paid for from general revenues may be gradually reduced until at design flow all revenues result from the user charges.

Exclusions and Additions

The foregoing Guidelines relate to the general provisions of the regulations. These are within the context of the regulation provision that the application shall assure the Administrator that the applicant will require pretreatment of any industrial waste which would otherwise be detrimental to the treatment works or its proper and efficient operation and maintenance, or will otherwise prevent the entry of such waste into the treatment plant.

In addition to provisions set forth herein, EPA evaluation of cost recovery systems will follow general principles previously set forth by interim Guidelines and any subsequent provisions.

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APPENDIX

Examples

EXAMPLE A

Project Costs	$2,500,000
Ineligible Costs*	- 500,000
Eligible Costs	2,000,000
PL 660 Grant (30%)	- 600,000
Eligible Costs exclusive of PL 660 Funds	1,400,000
Ineligible Costs*	+ 500,000
Total Allocable Capital Costs (Local)**	1,900,000

* Ineligible costs are subtracted out before the PL 660 grant computation is made; these costs MAY be added back if in fact they are costs to be borne by the applicant, in computing the base for the allocation formula (EPA CANNOT REQUIRE THE INCLUSION OF COSTS OF LAND, PRE-TREATMENT, AND COLLECTION SEWERS IN THE RECOVERY BASE).

** To be shared by the applicant and participant industries.

EXAMPLE A'

Total Allocable Capital Costs (Local) (From Example A)	$1,900,000
	x .065*
Uniform Annual Amount**	$ 123,500

* Capital Recovery Factor, 30 years at 5%--See Grant and Ireson, Principles of Engineering Economy, Fourth Edition.

(The capital recovery factor, when multiplied by the present value of the capital costs, gives the uniform annual end-of-year payment necessary to repay the debt in n years with interest rate i.)

** Operation and maintenance costs are added to this total to arrive at total annual costs, the base of the cost-recovery formula.

EXAMPLE B

Project Costs	$2,500,000
Ineligible Costs*	- 500,000
Eligible Costs	2,000,000
PL 660 Grant (50%)	-1,000,000
Eligible Costs exclusive of PL 660 Funds	1,000,000
State Grant (25%)	- 500,000
Eligible Costs exclusive of all Grants	500,000
Ineligible Costs*	+ 500,000
Total Allocable Capital Costs (Local)**	1,000,000

* Ineligible costs are subtracted out before the PL 660 grant computation is made; these costs MAY be added back if in fact they are costs to be borne by the applicant, in computing the base for the allocation formula (EPA CANNOT REQUIRE THE INCLUSION OF COSTS OF LAND, PRE-TREATMENT, AND COLLECTION SEWERS IN THE RECOVERY BASE).

** To be shared by the applicant and participant industries.

EXAMPLE C

Total Allocable Capital Costs (Local)*	$1,000,000
Less excess capacity portion**	- 300,000
Utilized capacity portion of allocable capital costs***	700,000

* Total capital costs to be funded, from Example B.

** Excess capacity portion, assume 30% of design facility; 30% of capital costs should therefore be paid for out of general revenues.

*** Annualized capital costs of this portion are included in the cost recovery formula.

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FEDERAL REGISTER

VOLUME 35 • NUMBER 128

Thursday, July 2, 1970 • Washington, D.C.

Title 18—CONSERVATION OF POWER AND WATER RESOURCES

Chapter V—Federal Water Quality Administration, Department of the Interior

PART 601—GRANTS FOR WATER POLLUTION CONTROL

Subpart B—Grants for Construction of Treatment Works

On March 31, 1970, notice of proposed rule making was published in the FEDERAL REGISTER (35 F.R. 5346) which set forth the text of regulations, proposed to amend Subpart B relating to basin plans, regional or metropolitan plans, industrial waste treatment, design and inspection of waste treatment facilities.

Pursuant to the above notice, a number of comments have been received from interested persons, and due consideration has been given to all relevant matter presented. In light of the preceding, a number of revisions have been made in the rules as proposed.

In accordance with the statement in the notice of proposed rule making, Subpart B of Part 601, as set forth below, is hereby adopted effective on publication.

Subpart B—Grants for Construction of Treatment Works

Sec
601.32 Basin control
601.33 Regional and metropolitan plan.
601.34 Industrial waste treatment.
601.35 Inspections.
601.36 Design.

AUTHORITY: The provisions of this Subpart B issued under section 8 of the Federal Water Pollution Control Act, as amended (70 Stat. 502; 33 U.S.C. 466e) and section 22(a) of the Act, as amended (75 Stat. 204; 33 U.S.C. 466).

§ 601.32 Basin control.

(a) No grant shall be made unless the Commissioner determines, based on information the State, or where appropriate, the interstate agency, for the areas within their respective jurisdictions, furnishes to him pursuant to paragraph (b) of this section that a project is included in an effective current basin-wide plan for pollution abatement consistent with applicable water quality standards.

(b) In reaching such determination, the Commissioner may require information in such manner as he prescribes concerning the total basin plan, or portion thereof, as he deems adequate to evaluate the effectiveness of the project. Such information shall be furnished within one year of the date of the Commission's request for such information. The Commissioner may extend this period for proper cause. For this purpose, the affected river basin waters shall be deemed not to include any waters outside the State in which the project is located but shall include waters in another State if an interstate agency has jurisdiction of the additional affected basin waters. The Commissioner shall consider whether the plan adequately takes into account all, or such as may be appropriate, of the following:

(1) *Sources of pollution.* An identification list of all significant point sources of waste discharges; municipal, industrial, agricultural and others.

(2) *Volume of discharge.* The average daily volume of discharge produced by each waste discharger. Cooling water, or cooling water which is contaminated by industrial waste or sewage shall be reported separately. Storm water and mixed storm water and sewage shall be identified and reported separately in terms of frequency-volume relationships.

(3) *Character of effluent.* The major characteristics of each such waste discharge together with a measurement of their relative strength or concentrations, including but not limited to:

BOD 5	mg/l.
COD	mg/l.
Color	Platinum cobalt scale.
Turbidity	Jackson candle scale.
Solids	mg/l.
Toxic substances	
Metal Ions	mg/l.
Fluorides	mg/l.
Dissolved substances	ppm
Temperature	C.
pH	
Radioactivity	pCi/l.
Chlorides	mg/l.
Nutrients	mg/l.

(4) *Present treatment.* A brief description of the type of treatment being given by each discharger, together with a statement of the degree of treatment currently being achieved.

(5) *Water quality effect.* A brief description of the effect of discharges and abatement practices upon the quality of the water in the basin, and the anticipated effectiveness of the proposed project in improving the quality of the water.

(6) *Detailed abatement program.* Identify all waste discharges for which present treatment is less than required by standards, or which will degrade water quality below standards. For each such discharge so identified, furnish an abatement schedule containing the following:

(i) Level of treatment to be required expressed in percentage of reduction of BOD and/or any other significant parameters required pursuant to applicable Federal, State and interstate laws, regulations and orders.

(ii) Volume of flow for which waste treatment facilities will be designed.

(iii) Estimated completion dates for preliminary plans, for final design, for construction, and for operation of waste treatment facilities.

(iv) Estimated cost of design and construction if available.

(c) If the proposed project is not included in an effective basin-wide plan for pollution abatement, and the Commissioner determines that such project will nevertheless effectively contribute to the improvement of the quality of the water or prevention of water pollution in the basin, he may waive the limitation of paragraph (a) of this section. In making his determination the Commissioner may require all or a part of the information identified in paragraph (b) of this section.

(d) The Commissioner's discretion in determining the desirability of any project shall not be limited by any provision of any basin-wide abatement plan pursuant to this section.

§ 601.33 Regional and metropolitan plan.

(a) A grant for a project shall not be made unless the Commissioner determines that such project is included in an effective metropolitan or regional plan developed or in the process of development, and certified by the Governor or his designee as being the official pollution

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abatement plan developed or in the process of development for the metropolitan area or region within which the project is proposed to be constructed. In the case of an interstate metropolitan or regional area, the plan shall be certified by the respective Governors or their designees.

(b) In reaching such determination the Commissioner shall consider whether such plan adequately takes into account: Anticipated growth of population and economic activity with reference to time and location; present and future use and value of the waters within the planning area for water supplies, propagation of fish and wildlife, recreational purposes, agricultural, industrial and other legitimate uses; adequacy of the waste collection systems in the planning area with reference to operation, maintenance and expansion of such systems; combination or integration of waste treatment facilities into a waste treatment system so as ta achieve efficiency and economy of such treatment; practicality and feasibility of treating domestic and industrial waste in a combined waste treatment facility or integrated waste treatment system; need for and capacity to deal with waste from sewers which carry storm water or both storm water and sewage or other wastes; waste discharges presently in, or anticipated for the planning area; effect of the proposed waste treatment facility upon the quality of the water within the planning area with reference to other waste discharges and to applicable water quality standards.

(c) If the proposed project is not included in an effective metropolitan or regional plan for pollution abatement, and the Commissioner determines that such project will nevertheless effectively contribute to the prevention of pollution or improvement of the quality of the water in the metropolitan area or region, he may waive the limitation of paragraph (a) of this section. In making his determination the Commissioner may require all or a part of the information identified in paragraph (b) of this section.

(d) The Commissioner's discretion in determining the desirability of any project shall not be limited by any provision of any metropolitan or regional plan pursuant to this section.

§ 601.34 Industrial waste treatment.

(a) Where a project will treat industrial wastes, a grant may be made in the discretion of the Commissioner for such project provided that it is included in a waste treatment system treating the wastes of the entire community, metropolitan area or region concerned. For the purposes of the section "waste treatment system" means one or more treatment works which provide integrated, but not necessarily interconnected, waste disposal for a community, metropolitan area or region.

(b) If industrial waste is to be included in the waste treated by the proposed project, the applicant shall assure the Commissioner that such applicant will require pretreatment of any industrial waste which would otherwise be detrimental to the treatment works or its proper and efficient operation and maintenance, or will otherwise prevent the entry of such waste into the treatment plant.

(c) Where industrial wastes are to be treated by the proposed project the applicant shall assure the Commissioner that it has, or will have in effect when the project will be operated, an equitable system of cost recovery. Such system of cost recovery may include user charges, connection fees or such other techniques as may be available under State and local law. Such system shall provide for an equitable assessment of costs whereby such assessments upon dischargers of industrial wastes correspond to the cost of the waste treatment, taking into account the volume and strength of the industrial, domestic, commercial wastes and all other waste discharges treated, and techniques of treatment required. Such cost recovery system shall produce revenues, in proportion to the percentage of industrial wastes, proportionately, relative to the total waste load to be treated by the project, for the operation and maintenance of the treatment works, for the amortization of the applicant's indebtedness for the cost of such treatment works, and for such additional costs as may be necessary to assure adequate waste treatment on a continuing basis. For purposes of this section "industrial waste" shall mean the waste discharges (other than domestic sewage) of industries identified in the Standard Industrial Classification Manual, Bureau of the Budget, 1967, as amended and supplemented, under the category "Division D—Manufacturing," and such other wastes as the Commissioner deems appropriate for purposes of this section.

§ 601.35 Inspections.

No grant shall be made for any project unless the State water pollution control agency assures the Commissioner that the State will inspect the treatment works not less frequently than annually for the 3 years after such treatment works are constructed and periodically thereafter to determine whether such treatment works are operated and maintained in an efficient, economic and effective manner and unless the applicant assures the Commissioner that the treatment works will be maintained and operated in accordance with such requirements as the Commissioner may publish from time to time concerning methods, techniques and practices for economic, efficient and effective operation and maintenance of treatment works.

§ 601.36 Design.

No grant shall be made for any project unless the Commissioner determines that the proposed treatment works are designed so as to achieve economy, efficiency and effectiveness in the prevention or abatement of pollution or enhancement of the quality of the water into which such treatment works will discharge and meet such requirements as the Commissioner may publish from time to time concerning treatment works design so as to achieve efficiency, economy and effectiveness in waste treatment.

Dated: June 24, 1970.

FRED J. RUSSELL,
Acting Secretary of the Interior.

[F.R. Doc. 70-8396; Filed, July 1, 1970; 8:46 a.m.]

"Reprinted with permission from Sewage and Industrial Wastes, Vol. 23, No. 12, Page 1493, (December, 1951), Washington, D.C. 20016."

Industrial Wastes

DETERMINATION OF FAIR SEWAGE SERVICE CHARGES FOR INDUSTRIAL WASTES *

By George J. Schroepfer

Professor of Sanitary Engineering, University of Minnesota, Minneapolis, Minn.

The increasing consciousness of the seriousness and the magnitude of the industrial waste problem in this country has awakened interest in the corollary consideration of raising the revenue requirements for remedial works.

The magnitude of the problem is pointed up by a survey of the Public Health Service (1), which finds that there are 10,401 industries discharging wastes into the watercourses of the United States. Another survey by the National Association of Manufacturers (2) of more than 3,000 industries indicates that 82 per cent of the industries provide no treatment whatsoever. One interesting finding of this survey is that more than two-thirds (69 per cent) of the industries discharge all or a part of their wastes into the municipal sewage works. It is with this fraction that this paper is concerned.

With 11,811 municipalities having sewer systems, and 6,628 having sewage treatment plants (1), and recognizing that most receive industrial wastes to some extent, the magnitude of the present problem is apparent. And with 4,200 municipalities requiring new sewage treatment plants (1), the problem of the future will be magnified. This is particularly true because annual costs, usually quite low proportionately when sewage is discharged untreated through sewer systems, increase markedly when treatment facilities are provided.

This paper is concerned, therefore, with the problem of presenting a fair basis of charges to industry in the usual situation where its wastes are discharged into the municipal system. It is limited to a consideration of those wastes which are amenable to treatment in conventional plants, and excludes such wastes which because of their toxicity or chemical composition would cause serious difficulties in the plant or subsequently in the receiving waters.

The approach to this problem as presented herein lies in the principles enunciated by a Joint Group of 24 members consisting basically of committees of the American Society of Civil Engineers and of the Section of Municipal Law of the American Bar Association, but with representation by six other participating organizations, including this Federation. Samuel A. Greeley and John D. McCall served as general chairmen of the engineering and law committees, respectively. Other members of the Federation who served on the Joint Committee were Francis S. Friel, Thomas M. Niles, Myron W. Tatlock, and the writer. After more than three years of work the Committee has issued its report entitled "Fundamental Considerations in Rates and Rate Structures for Water and Sewage Works" (3).

* Presented at 24th Annual Meeting, Federation of Sewage and Industrial Waste Associations; St. Paul, Minn.; October 8-11, 1951.

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Inasmuch as the report has not as yet been widely circulated, this paper of necessity must review the basic principles upon which it is founded to introduce the reader to the procedures involved as applied to the determination of fair charges for the handling of industrial wastes. However, for a complete discussion of the problem, the author recommends the report as representing the considered thought and judgment of a representative group of engineers, lawyers, and finance authorities interested in the question.

Certain Basic Considerations

Preliminary to a consideration of the methods of charging for industrial wastes handling in a municipal system, it is important to give consideration to certain basic factors involved. A municipality, in determining a course of action with respect to the reception of industrial wastes into its system, may consider, among others, the following possibilities:

1. To exclude industrial wastes:
   - (a) All industrial wastes.
   - (b) Certain industrial wastes which, because of their constituents (toxicity, acidity, etc.), impair the functioning of the municipal system.
2. To require pretreatment at the source:
   - (a) All industrial wastes to a level approaching the constituents in normal domestic sewage.
   - (b) Certain wastes which, because of their constituents or excessive load variation, are harmful to the system.
3. To receive industrial wastes:
   - (a) All industrial wastes.
   - (b) All wastes except those which are not amenable to treatment or would cause real difficulties in the operation of the system.

The decisions made concerning this question influence the financing problems confronting the city. Obviously, if course 1(a) is followed, no direct financial decisions need be made concerning the charges. But, because of the importance of industry in a community, this procedure is unrealistic. The costs of separate treatment by each industry are likely to be much greater than combined treatment, not to mention the administrative problems confronting regulatory agencies. Course 2(a) apparently simplifies the problem, because after pretreatment by industry to the level of ordinary sewage the industry can be charged at the rate for other general users of the system. It is subject, perhaps to a lesser extent, to the same objections as course 1(a)—namely, higher total costs and administrative difficulties. Course 3(a) is likely to result in certain wastes seriously destroying the efficiency of the sewage works or markedly increasing costs beyond a point of reasonableness. The admittance of very toxic wastes would be an example.

Thus, it will be apparent to most that the proper procedure, and that followed by most municipalities, is the middle ground represented by courses 1(b), 2(b), or 3(b), alone or in combination. According to the Public Health Service (1), more than 60 per cent of the industries contribute organic wastes. Most of these are susceptible to treatment in conventional processes. However, increased costs of construction and operation are involved, and this brings up the topic of charges.

Methods of Charging in Use

In the approximately 12,000 communities in this country having sewerage facilities, a number of methods are employed for raising the revenue required to construct and operate them; and, therefore, for charging industry

for the reception of its wastes. Some of these methods are:

1. The ad valorem tax on property. Historically (since colonial days) this has been the commonly accepted method (in more than 80 per cent of U. S. communities) of raising the revenue requirements. When the sewage works were limited to sewer systems with disposal into the nearest watercourse, operation budgets were small and, in general, this method brought few objections.

2. Special assessments. Special assessments on a front footage basis against abutting property are quite commonly used as a method of payment for all or a part of the cost of construction of sewer systems.

3. Sewage service charges. From the time of first application in Brockton, Mass., in 1894, sewage service charges have come to be used as a method of raising revenue. Although no complete recent surveys are available, it is estimated that approximately 1,000 municipalities (or one-sixth of those having treatment plants) now use this method of charging. A number of procedures are employed (as many as 12), the principal one being related to the volume of water consumed on the premises. In a few cases constituents in the sewage are included in the rates, in one way or another.

4. Special negotiated contracts with industry. The bases for these contracts vary, but in several the incremental (added cost) method has been employed.

5. Combinations of two or more of the above methods.

It is desirable to discuss certain of these methods in some detail. It is obvious that when the property tax basis is used to raise the total annual revenue (fixed charges and operation and maintenance costs), the use of, and the benefits received from the works is not measured. Used alone, this measure of ability to pay, rather than of service rendered, is no more valid than the old English system of taxing on the basis of number of windows on the premises. Fairness to all users and properties is not achieved by this method as the sole basis of charge. However, because the value of property, both developed and undeveloped, is enhanced by reason of the existence of the sewage works, this is some measure of benefit, the extent of which is discussed in a later section.

Attention is called to the use of the term "sewage service charge" rather than "sewer rental charge" or "sewer service charge." The Joint Committee believes that this terminology is more descriptive of what is included in the charge and leads to fewer necessary explanations. With this out of the way, it can be stated with equal validity that to base all charges on a schedule of sewage quantity or some similar base is improper. Under this method present users of the system pay an unfair proportion of the cost of the system, which is designed partly as a benefit to property. This also is discussed at length later. This method becomes even more unfair when excess collections are paid into the general fund, or are used to finance new construction or extensions of the sewer system.

Several writers have called attention to the incremental method of negotiating contracts with industry. This method involves determining the charge to industry on the added or excess cost basis, wherein the costs of a combined system are estimated, and by subtracting the costs of a system without industry being included, the incremental costs are determined. This method can be used in reverse. In some situations the industrial wastes make up half or more of the load. If the cost of a combined system is estimated and the cost of a plant for the industrial wastes is subtracted, a quite different answer results. Which is proper? This method is indefinite and not susceptible of ac-

curate analysis, particularly on a long-established system. And it changes with time, as industry and community growth is often different.

Where a combination of methods 1, 2, and 3 has been used, the allocation of costs sometimes approaches fairness. In the past, this has been happenstance only. Thus, where general obligation bonds have been issued, and a property tax employed for debt service, with sewage service charges for operation and maintenance costs, both property and users share in the costs, although not very often in a fair proportion.

Some of the methods of determining charges have been discussed in a general way. It was first planned to present in detail the methods of charging employed by a number of communities. Because of space limitations and in view of the wide variance in practice, it was finally decided that this would serve no useful purpose. Influenced by political expediency and precedent, and affected by the social philosophy of governing bodies in their outlook towards present and potential industry, charges vary from extremely low ones (a subsidy to industry, and unfairness to other classes of users and property) to burdensome and confiscatorially high ones. In general, past practice is of little aid in approaching the subject of fairness in charges.

Suggestions for Charges to Industry

Many articles have been published on the subject of charges for industrial wastes in a municipal system. These take many points of view. The literature is replete with suggestions that not only volume, but also strength, should be considered in making charges. Chronologically, and to mention only a few, Greeley (4), Marston (5), Calvert (6), Mohlman (7)(8)(9), Hommon (10), Mahlie (11), Knowlton (12), Beselievre (13), La Due (14), Russell (15), and Laboon (29) have suggested the desirability of considering sewage composition in determining charges. The methods proposed for accomplishing this have varied widely.

A number of writers have discussed and some have advocated the incremental method of charging for industrial wastes. Among these may be mentioned Warrick (16), Green (17), Enslow (18), Cohn (19), Gray (20), and Haseltine (21). Several have employed or advocated the use of formulas to determine service charges, including Symons (22)(23)(24)(25)(26), Wright (27), Reaves (28), and Laboon (29).

In general, these articles do not discuss the question of just what proportion of the total annual charges should be or are covered by the methods suggested or employed. Furthermore, in later years very little reference is made to the share which should properly be borne by property. Nor to the writer's knowledge is mention made of a reasonable allocation of the total annual costs except in papers by Greeley (30)(31)(32).

In foreign countries attention is also being given to this problem. Mohlman (8) discusses practice in the Emscher and Ruhr Districts, in Germany, where surcharges for industrial wastes based on production and type are made. The 1937 Public Health Act (Drainage of Trade Premises) (8)(33) in England states that in setting rates, " . . . regard (shall be) had to the volume and composition of trade effluents and to any additional expense incurred in connection with their reception." And even England has its formula developers in the person of Townend (33). The Council of the South African Branch, Institute of Sewage Purification, adopted the following statement of policy (34):

"The charges for industrial waste disposal should be in relation to the waste load contributed by the industry.

"The charge levied against an industry

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for the load contributed should not be made with a view to profit or loss, but should be based on the established cost price of treatment of the mixed sewage entering the works."

A rather unusual viewpoint (to many), but not surprising, perhaps, in view of the nationalization program in England, is the suggestion by Hurley (35) of a national basis of solution to this problem, with every manufacturer contributing to a central fund a standard amount based on character and volume. From the central fund local authorities would be reimbursed for treating the industrial wastes in their plants. It is hoped that neither our aims nor our tendencies are in that direction.

Returning to practice in the United States, the implications of the following statement in the Report of the Ohio River Committee (34) published in 1944 are intriguing:

"There are several basic considerations which underlie the problem of equitably distributing the cost of pollution abatement works. Among these considerations it may be contended that industries exist only in response to public demand for their products and, therefore, that the public is indirectly responsible for all stream pollution, both industrial and domestic, and ultimately must bear the cost of all pollution-abatement activities, either by direct expenditures or partially by direct expenditures and partially in the form of increased costs for industrial products."

In view of what has already been discussed concerning the confusion in practice and in the thinking on this subject, is it any wonder, therefore, that municipal officials and industries experience difficulty in approaching this problem? Fundamental considerations have been, and are being, more and more lost sight of.

Fundamental Principles Involved

The aim of engineers and administrators involved is to establish fair rates and rate structures which measure the benefits from, and use of, the sewage works. The approach to the problem can be found in a statement of fundamental principles involved, prepared after considerable thought and discussion by the Joint Committee:

"The needed total annual revenue of a water or sewage works shall be contributed by users and non-users (or by users and properties) for whose use, need, and benefit the facilities of the works are provided, approximately in proportion to the cost of providing the use and th benefits of the works."

From what has already been written, it is obviously unfair to raise the annual revenue requirements entirely by a charge on property, as is done when ad valorem taxes are employed to raise the total annual amount. Similarly, it is unfair to expect the present users to pay the entire cost, as is done when sewage service charges are designed to raise the entire annual revenue requirements.

The report goes on to state:

"It is considered that rates and rate structures for water and sewage works should achieve fairness through payment by each user or beneficiary of his fair share of the total annual cost of the works required, and no more."

The above general statement is one with which almost everyone will agree, but depending on where one "sits at the ball game" his viewpoint of what approaches fairness will differ. As applied to the subject of this paper, even the viewpoints of industrial representatives, who for purposes of our analogy should be on the same "team," will differ, depending on whether they represent a "dry" or a "wet" industry. The governing bodies and the citizens they represent may well be confused in their thinking.

In approaching the problem presented by the Joint Committee state-

ment of fundamental principles, it becomes necessary to consider its various component parts.

Total Annual Revenue Requirements

The annual revenue requirements of a sewage works may be divided for this purpose into those which are needed for (1) the collection system, including pumping stations; (2) the intercepting sewers; and (3) the treatment plant. The revenue requirements for these major units are commonly subdivided as follows:

1. Operation.
2. Maintenance and replacement. (The latter item may be covered by a depreciation expense item in some cases.)
3. Fixed charges or debt service, including interest and amortization of the bonds required to finance the construction of the project. A depreciation allowance may be provided where the useful life of the works, including obsolescence, does not correspond to the bond period.

All of the above three items of the various component parts of the works constitute important and essential items of expense in constructing and operating the system and should be included in any approach to a fair allocation of costs.

Contributions by Users and Properties

The Joint Committee report makes a definite point, and is predicated upon contributions by both users and properties. In justification of the premise, it will be readily apparent that surface and subsurface drainage is related to area or property and has no relation to use as represented by the discharge of "spent" water or sewage; therefore, a charge based upon area or property is proper for this element of service. Similarly, the provision of capacity in the component parts of a sewage works for the future provides for the security and development of property and for community growth, and is a proper charge on property, as it is obviously unfair to charge present users based on sewage contribution for this cost element. In fact, undeveloped property in fairness should provide the major portion of this cost, because capacity is provided for this later use. The amount allocated to property would decrease with time as the use of the works approached capacity. The charge to property can be distributed on a front foot, area, or property valuation basis, or on a combination method.

The user, on the other hand, is responsible for certain items of cost. A portion of the collection and intercepting sewer is allocated for his use. To a greater degree the fixed charges on the plant, and to an even greater extent the operating cost of the plant, is caused by his use of the works.

Allocation of Costs in Proportion to Benefits and Use

At the time of construction, or periodically thereafter, it is possible for an engineer to determine with reasonable accuracy the relative proportions of the works and of the costs which are chargeable to users and to property. Thus, a building sewer renders a direct service to the property benefited and is chargeable to that property. In proceeding downsewer (figuratively), a continually lesser proportion of the capacity of the sewer is chargeable against that property. In the case of the intercepting sewer it is possible to determine and allocate the portion of the cost chargeable to property (surface runoff, ground-water infiltration, future capacity, public use, etc.) and that chargeable to the user (domestic sewage, industrial wastes). Furthermore, in the case of the sewage treatment works the various parts are affected differently by the volume and characteristics of the liquid wastes and, therefore, the special service which par-

ticular users and properties (such as an industry, for example) receive, can and should be evaluated. Thus, the sewage pumping and sedimentation costs are affected in design and, therefore, in resultant costs, principally by volume. Oxidizing processes, on the other hand, are influenced principally by organic loading, and sludge disposal processes by solids content.

By attacking each unit of the sewage works in this manner it is possible, first, to allocate the various portions to use and to property, and then later to distribute these allocated amounts, depending on the actual expenditures which these cause. Having determined the amount to be allocated to property, it is possible to set up a schedule of charges to property based on front footage, area, or (more usually) assessed valuation. A combination has been used in at least one case. The allocation to users can be distributed on a volume, organic loading (represented by B.O.D.), and solids content basis. Depending on the situation, chlorine demand may replace or be used in conjunction with the organic loading.

Because the aim is to achieve fairness to all users and beneficiaries (domestic, commercial, and industrial alike), it becomes necessary to consider the question as a whole and not simply from the standpoint of any one class (such as an industry). Therefore, what might appear at first glance to be too broad an approach to the subject of this paper, should be justified to the reader as the detailed procedures involved are considered later.

Realizing the difficulty of considering this subject in abstract or general terms, the author has prepared a typical example of a situation, which will illustrate the procedures involved. Before considering this, it should be emphasized again that the basic consideration involved is that both users and properties should share fairly in raising the needed revenue requirements. Having determined this fair allocation, the distribution between various users and properties in a rate structure becomes a detail, although admittedly an important one.

Illustrative Example of Procedures Involved

Assumed Conditions

Assume that a rate schedule is to be determined for a community, with a present population of 30,000, in which a system of intercepting sewers and a sewage treatment plant have recently been constructed. In this community it is assumed that a large wet industry, among others, is located; and it is desired to determine the fair costs which should be charged that major industry. It is further assumed the wastes have a variation with time similar to domestic sewage, and are amenable to treatment.

1. Present flows and those used as a basis of design of the plant and intercepting sewers are as follows:

Flow Source	Present Average Flow (m.g.d.)	Flow Basis of Design (m.g.d.)	
		Plant (1970)	Sewers (2000)
Sewage[1]	3.00	4.50	12.00
Major industrial waste	0.75	0.90	2.00
Ground-water infiltration	0.50	0.60	2.00
Storm-water runoff	—	—	4.00
Contribution from public use	0.25	0.30	0.80
Total	4.50	6.30	20.80

[1] Sources exclusive of major industry.

2. The average strengths of the sewage and industrial wastes are assumed as follows:

	Susp. Sol. (p.p.m.)	5-Day B.O.D. (p.p.m.)
All sources excl. of industry	250	200
Major industrial waste	350	700

3. Assessed valuations are as follows:

Entire community (incl. major industry)	$20,000,000
Major industry	$500,000

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4. Construction costs of the various units are as follows:

Unit	Constr. Cost ($)
Intercepting sewers[1]	700,000
Treatment plant:	
Main pumping station	
Equipment	30,000
Structures	25,000
Screen and grit chambers	30,000
Preliminary sed. tanks	90,000
Trickling filters	600,000
Final sed. tanks	180,000
Recirculation pumps	15,000
Chlorination[2]	40,000
Dig. tanks and vac. filters	160,000
Main control building	150,000
Plant water supply	50,000
Roads and grounds	50,000
Plumbing and heating	80,000
Total treatment plant	1,500,000
Total Construction Cost	2,200,000

[1] For purposes of simplicity, costs of collecting sewers are not included.
[2] Contact tanks and equipment.

5. It is further assumed that the fixed charges are limited to interest and bond retirement, and that the bond period corresponds to the useful life of the structures. Assumed debt service charges are bond retirement 4 per cent annually, and interest charges at an average of 1 per cent (2 per cent interest rate), or a total of 5 per cent.

6. Operation and maintenance costs are as follows:

	Labor and Supervision	Power and Light	Materials and Supplies	Maint., Repairs, and Replacements	Total
Intercepting sewers	$ 1,000	—	—	$ 1,200	$ 2,200
Main pumping station	3,000	$ 5,000	$ 200	1,000	9,200
Preliminary treatment	5,000	1,000	200	500	6,700
Secondary treatment	5,000	3,000	500	5,000	13,500
Effluent chlorination	2,000	—	3,000	200	5,200
Sludge disposal	7,000	2,000	4,500	4,000	17,500
General	1,000	2,000	1,000	1,000	5,000
Supervisory	6,000	—	200	—	6,200
Collection and billing	5,000	—	—	—	5,000
Total	$35,000	$13,000	$9,600	$12,900	$70,500

Allocation of Charges Between Users and Properties

Having set forth the assumed conditions, it becomes necessary to apportion the needed annual revenue requirements between users and property on the basis of the fundamental considerations that have been discussed. The total annual revenue requirements are, therefore, as follows:

Fixed charges:	
Intercepting sewers	$ 35,000
Treatment plant	75,000
Operation and maintenance costs	70,500
Total annual charges	$180,500

1. Fixed charges—intercepting sewers. Considering the allocation (between users and property) in the case of the intercepting sewers, it will be seen that the proportion of the capacity of the intercepting sewers used or occupied by storm-water runoff and ground-water infiltration bears no relation to the use made by the direct contributor of sewage or wastes and, therefore, is properly chargeable to property. In the same way, the proportion of the capacity provided for the future (50 years from present) is also a proper charge to property. It can similarly be shown that the contribution of sewage from the public use of water can reasonably be charged to property. In Figure 1 are shown the relative proportions which might be allocated to users and to property in

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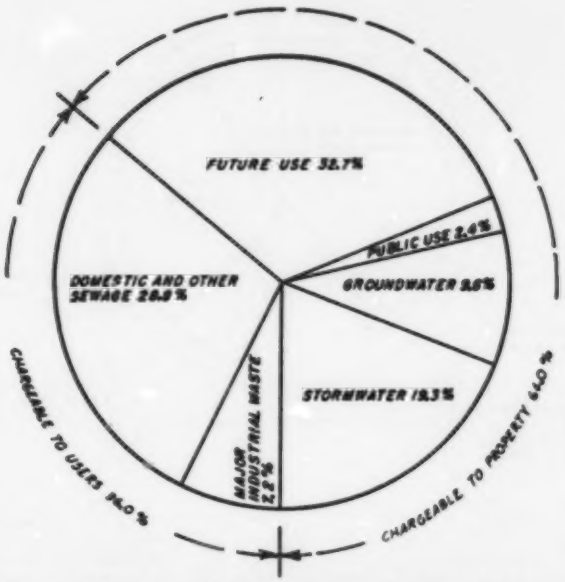

FIGURE 1.—Allocation of fixed charges on the intercepting sewers.

the case of fixed charges on the intercepting sewers. Of the total fixed charges on the intercepting sewers ($35,000), 19.3 per cent is caused by storm water (4.0 m.g.d. of the total capacity of 20.8 m.g.d.), 9.6 per cent by ground water, 32.7 per cent by future provisions, and 2.4 per cent by public use (municipal buildings, etc.), or a total of 64 per cent chargeable to property. The allocation to users is 28.8 per cent by domestic users and others, and 7.2 per cent to the major industry, or a total of 36 per cent.

2. Fixed charges—treatment plant. In the case of the fixed charges on the treatment plant (amounting to $75,000 annually), it will be seen that the relative proportion which should properly be charged to users and property will differ in the various units. Thus, the proportion chargeable to property in the case of screens and grit chambers, pumps, sedimentation tanks, conduits, and outfalls, in which the design is based principally on volume, will be considerably greater than for digestion tanks, in which the principal design consideration is the suspended solids removed from the sewage. Similarly, the principal design consideration in the case of secondary treatment is the B.O.D. of the sewage. Figure 2 illustrates the basic volume distribution between users and property for this part of the problem, and indicates that 59.5 per cent can properly be charged to present users and 40.5 per cent to property for works that are principally influenced by volume. It should be pointed out that 28.5 per cent of the total cost is chargeable to future use on a volume basis. As time progresses and subsequent allocations are made, this proportion should be reduced until it reaches zero in 1970 (the year for which the plant is designed).

In the case of plant units affected by organic and solids load, the proportion of the fixed charges chargeable to the future and, therefore, to property, can be estimated as follows:

	B.O.D. (lb.)	Susp. Sol. (lb.)
Present load (1950)	10,600	10,000
Design load (1970)	14,200	13,900
Chargeable to property (%)	25.4	28.1

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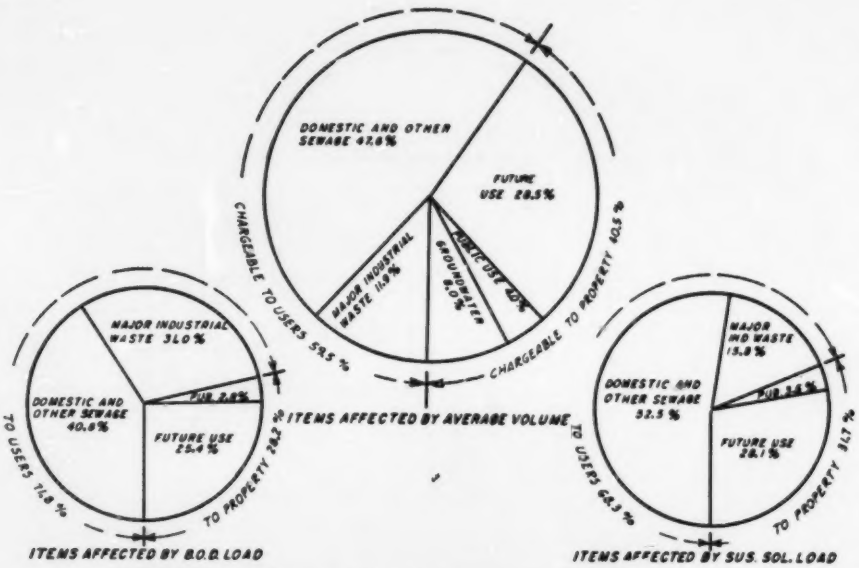
DOMESTIC AND OTHER SEWAGE 42.6%
FUTURE USE 28.5%
MAJOR INDUSTRIAL WASTE 11.9%
GROUNDWATER 8.0%
PUBLIC USE 9.0%
CHARGEABLE TO USERS 59.5 %
CHARGEABLE TO PROPERTY 40.5 %
ITEMS AFFECTED BY AVERAGE VOLUME
MAJOR INDUSTRIAL WASTE 31.0%
DOMESTIC AND OTHER SEWAGE 40.6%
PUB 2.8%
FUTURE USE 25.4%
TO USERS 74.8 %
TO PROPERTY 25.2 %
ITEMS AFFECTED BY B.O.D. LOAD
MAJOR IND WASTE 15.0 %
DOMESTIC AND OTHER SEWAGE 52.5 %
PUB 3.4 %
FUTURE USE 29.1 %
TO USERS 64.3 %
TO PROPERTY 35.7 %
ITEMS AFFECTED BY SUS. SOL. LOAD

FIGURE 2.—Allocation of fixed charges on the treatment plant.

Allowance should be made for the load contribution from public use as well, and this portion charged to property. The ground-water infiltration is assumed to carry no load and, therefore, is ineffective on these plant units.

Certain plant units having general use, such as the main control building, plant water supply, roads and grounds, plumbing and heating, etc., are impossible to apportion accurately unless the details of a special situation are in hand. In this illustrative case these units are apportioned by the average percentages arrived at for all other units exclusive of these four items.

TABLE I.—Allocation of Fixed Charges

	Total Fixed Charges ($)	Chargeable to Property		Chargeable to Users ($)	User's Share Chargeable to					
					Volume		Susp. Solids		B.O.D.	
		(%)	($)		(%)	($)	(%)	($)	(%)	($)
Intercepting sewer	35,000	64.0	22,300	12,700	100.0	12,700	—	—	—	—
Treatment plant:										
Main pumping station										
Equipment	1,500	40.5	600	900	100.0	900	—	—	—	—
Structures	1,250	64.0	800	450	100.0	450	—	—	—	—
Screen and grit chambers	1,500	64.0	950	550	60.0	330	40.0	220	—	—
Preliminary sed. tanks	4,500	40.5	1,800	2,700	85.0	2,300	15.0	400	—	—
Trickling filters	30,000	25.0	7,500	22,500	10.0	2,250	—	—	90.0	20,250
Final sed. tanks	9,000	30.0	2,700	6,300	50.0	3,150	—	—	50.0	3,150
Recirculation pumps	750	25.0	200	550	—	—	—	—	100.0	550
Chlor. tanks and equip.	2,000	35.0	700	1,300	40.0	520	—	—	60.0	780
Dig. tanks and vac. filters	8,000	30.0	2,400	5,600	—	—	100.0	5,600	—	—
Sub-total	58,500	30.3	17,650	40,850	24.2	9,900	15.2	6,220	60.6	24,730
Main control bldg.	7,500	30.3	2,300	5,200	24.2	1,310	15.2	790	60.6	3,100
Plant water supply	2,500	30.3	800	1,700	24.2	410	15.2	260	60.6	1,030
Roads and grounds	2,500	30.3	800	1,700	24.2	410	15.2	260	60.6	1,030
Plumbing and heating	4,000	30.3	1,200	2,800	24.2	680	15.2	430	60.6	1,690
Total plant	75,000	30.3	22,750	52,250	24.3	12,710	15.2	7,960	60.5	31,580
Total fixed charges	110,000	41.0	45,050	64,950	39.2	25,410	12.2	7,960	48.6	31,580

TABLE II.—Allocation of Operation and Maintenance Costs

Structure or Function	Total Oper. and Maint. Cost ($)	Chargeable to Property		Chargeable to Users ($)	User's Share Chargeable to					
					Volume		Susp. Solids		B.O.D.	
		(%)	($)		(%)	($)	(%)	($)	(%)	($)
Intercepting sewers	2,200	60	1,300	900	60	500	40	400	—	—
Main pumping station	9,200	17	1,600	7,600	100	7,600	—	—	—	—
Preliminary treatment	6,700	50	3,400	3,300	50	1,700	50	1,600	—	—
Secondary treatment	13,500	15	2,000	11,500	10	1,200	—	—	90	10,300
Effluent chlorination	5,200	15	800	4,400	10	400	—	—	90	4,000
Sludge disposal	17,500	5	900	16,600	—	—	100	16,600	—	—
General	5,000	15	800	4,200	25	1,000	43	1,800	32	1,400
Supervisory	6,200	15	900	5,300	25	1,300	43	2,300	32	1,700
Collection and billing	5,000	15	800	4,200	25	1,000	43	1,800	32	1,400
Total	70,500	17.8	12,500	58,000	25.4	14,700	42.1	24,500	32.5	18,800

In total, the proportion of the total fixed charges on the plant ($75,000) allocated to property is $22,750, or 30.3 per cent of the total. For the entire system the distribution of the $110,000 fixed charges is $45,050 to property (or 41 per cent) and the balance (59 per cent) to users. The details of the allocation of the fixed charges are shown in the left-hand side of Table I.

3. Operation and maintenance costs. The allocation of the operation and maintenance costs, although approached in the same manner, results in quite different proportions charged to use and to property. Because dealings here are with present costs, charges for future capacity disappear and the proportion chargeable to the present users increases. Thus, in the case of power for sewage pumping, as an illustration, the proportion chargeable to property is 0.50 m.g.d. (infiltration) plus 0.25 m.g.d. (public use) divided by 4.50 m.g.d., or 16.7 per cent. In the case of sludge disposal facilities, however, because infiltration carries with it negligible suspended solids as they affect this operation, a maximum of 0.25/4.50 (or 5.6 per cent) can properly be charged to property. The major fraction of the cost of this operation should properly be chargeable to users on the basis of the suspended solids load.

As shown in Table II (left-hand columns) the approximate allocations made herein result in 17.8 per cent, or $12,500 of the total operation and maintenance costs of $70,500, being chargeable to property and the balance to use.

Summarizing the allocation of the fixed and operation charges:

	Chargeable to			
	Users		Property	
	%	Amount	%	Amount
Fixed charges:				
Intercepting sewers	36.0	$ 12,700	64.0	$22,300
Treatment plant	69.7	52,250	30.3	22,750
Operation and maintenance costs	82.2	58,000	17.8	12,500
Totals and averages	68.1	$122,950	31.9	$57,550

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TABLE III.—Allocation and Distribution of Total Annual Revenue Requirements

	Fixed Charges		Oper. and Maint.		Total Annual Charges	
	(%)	($)	(%)	($)	(%)	($)
Chargeable to property	41.0	45,050	17.7	12,500	31.9	57,550
Chargeable to users:						
Total	59.0	64,950	82.3	58,000	68.1	122,950
Volume	23.1	25,410	20.8	14,700	22.2	40,110
Susp. solids	7.2	7,960	34.8	24,500	18.0	32,460
B.O.D.	28.7	31,580	26.7	18,800	27.9	50,380
Total	100.0	110,000	100.0	70,500	100.0	180,500

The amount allocated to property ($57,550) can be distributed as a sewage charge to different classes of property in any one or combinations of methods already mentioned. For purposes of this illustration the ad valorem tax is employed. On the total assessed valuation of $20,000,000 this results in a millage rate of 2.88, or $2.88 per $1,000 of assessed valuation. This, then, is the first part of the sewage rate structure.

It now remains to distribute the user's share of $122,950 among the different classes of users.

Distribution of User's Share (Average Method)

As already mentioned, the construction and operation costs of the various units of a sewage works are influenced differently by the type of load they are called to operate on. Some units, such as the intercepting sewers, pumping stations, and preliminary sedimentation tanks, are principally affected by volume. The oxidizing units are primarily influenced by B.O.D. content and the sludge disposal works by suspended solids. Chlorination is principally affected by chlorine demand, which for simplicity in this illustrative example is assumed to be in proportion to the B.O.D. loading.

Tables I and II illustrate a distribution of the user's share by volume, suspended solids, and B.O.D. It should be pointed out that in this distribution, more so than in the case of the allocation to use and property, a considerable amount of judgment, reinforced by experience, must be brought into play. With the details of a particular situation in mind, however, the distribution is susceptible of relatively close calculation. Thus, if one considers a trickling filter unit with recirculation, the design of the distribution and underdrainage systems at first glance might be considered as affected entirely by volume. However, the quantity of flow recirculated is influenced by the B.O.D. loading, which fact must be considered in the distribution. The cost of the filter bed proper is almost wholly chargeable to B.O.D., as is the cost of recirculation.

The distribution of the user's share of $122,950, as calculated above, results in the following:

Chargeable to volume	$ 40,110
Chargeable to susp. solids	32,460
Chargeable to B.O.D.	50,380
Total	$122,950

The allocation between users and property, and the distribution of the user's share can now be summarized as in Table III and Figure 3.

Determination of Rates and Schedules (Average Method)

The sewage charge to property has already been determined as being 2.88

mills. The rates to users can be calculated as follows:

Chargeable to	Total Amount ($)	Annual Quantities	Unit Rate
Volume	40,110	1,370 m.g.	2.93¢ per 1,000 gal.
Susp. Sol.	32,460	3,647,000 lb.	$0.89 per 100 lb.
B.O.D.	50,380	3,874,000 lb.	$1.40 per 100 lb.

In the illustrative example the allocation and distribution has been calculated approximately, based on certain assumptions. This was necessary for purposes of simplicity, as otherwise the statement of assumed conditions would be undesirably long. In an actual situation certain other factors in addition to those mentioned would be considered. The example, nevertheless, illustrates the basic principles involved. Engineers might differ somewhat in the application of this method, but the committee believes that the principles are so eminently fair that courts and regulatory agencies will approve, even if the details of calculations are not entirely correct or fair.

In the illustration the contribution of sewage by public use has been charged against property. This amounts to between 2.4 and 4.0 per cent of the different parts of the works. A variation in this method suggested by the Joint Committee is based upon the reasoning that there is a public benefit in the form of improved general health and welfare, and in freedom from damage suits, by reason of the existence of the sewage works, and a percentage of cost can properly be charged as a general public benefit. This amount is intangible, but would be small (the Joint Committee report employs 5 per cent in an illustrative example.)

Furthermore, the above are the theoretical rates which would have to be charged to raise the needed annual revenue requirements. In an actual situation they would be made slightly higher to allow for possible non-collections and contingencies, or for discounts if such were to be applied.

Having completed the calculations for the illustration, it is interesting to

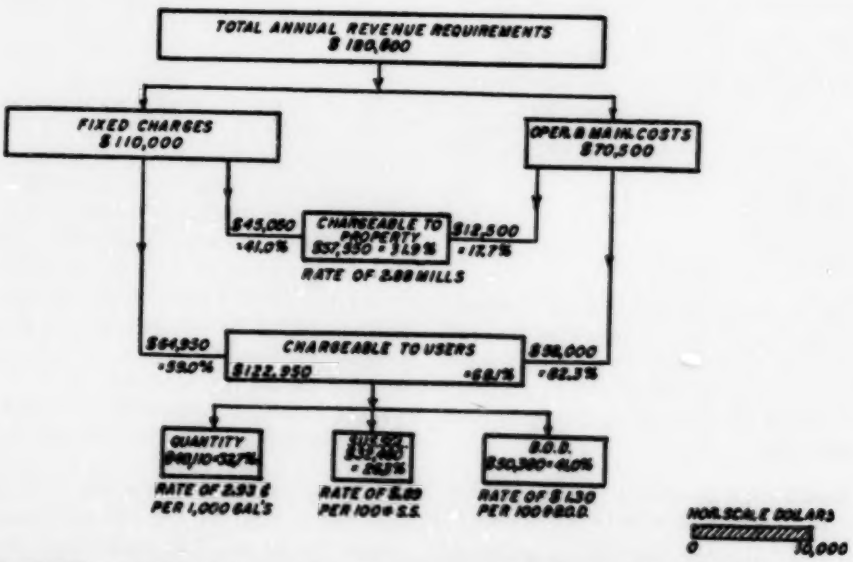

FIGURE 3.—Illustrative example. Allocation and distribution of total annual revenue requirements to users and to properties.

consider in a general way what would happen to the allocation for other sewage works involving differing units and proportions. In the illustration the construction cost of intercepting sewers is a small percentage of the total. In a situation where the sewers constitute a larger percentage of the total construction cost, the amount of the fixed charge allocated to property would increase from the value of 41.0 per cent determined herein. Also, where the degree of treatment is lower than assumed (complete treatment with effluent chlorination) the allocation between users and property and the distribution of the users share to quantity and quality would be materially different.

Depending on the situation, the relative proportions allocated to use and to property might vary materially from the values of 68.1 and 31.9 per cent determined herein. In the usual situation, somewhere between ½ to ¾ of the revenue requirements will be chargeable to users in the early years of a project. From information available to the writer, the results of apportionment made by one engineering office for four municipalities compared with the illustrative example as follows:

Municipality	Percent Chargeable to	
	Public and Property	Use
Decatur, Ill.	37.1	62.9
Winona, Minn.	49.4	50.6
Austin, Minn.	29.1	70.9
Buffalo, N. Y.	48.1	51.9
Illustration	31.9	68.1

The municipalities are quite different in type as related to industrial use and other factors. The illustration results in relatively low allocations to property as compared to most of the other communities.

Modification of User's Share Distribution on Readiness to Serve Principle

The foregoing calculations are based on the average method of distributing the user's share of the annual revenue requirements. In general, this follows the premise that users should pay in proportion to their average use of the system. In other utility rate-making, the tendency is to divide the costs based on two elements of service—the readiness to serve, or demand charge, and the actual use charge based on the quantity of the commodity consumed. The Joint Committee sets up a procedure for doing this. Essentially, the procedure involved is to divide the user's share into capacity costs (those influenced by demand), customer costs (billing and collection), and production costs (in this case pumping and treatment). In this case the three elements of costs are $71,350, $4,500, and $47,100, respectively. The Committee suggests that one-half of the capacity costs plus the customer costs be collected by demand or readiness to serve charges (or minimum bills) and the balance by the use charge. In this case then, the amount to be collected by demand or readiness to serve charges would be $\$71,350 \times ½ + \$4,500 = \$40,180$. The balance of the capacity cost plus the production costs, or $\$71,350 \times ½ + \$47,100 = \$82,770$ would be collected by the commodity or use charge.

The demand or readiness to serve charge might be distributed by a method which includes both volume and strength as reflected by the relative proportions of the fixed charges on construction. The maximum daily demand during the previous year might serve as a basis of this distribution, in the case of the major wet industry under discussion. For the usual contributors, the size of the water meter could be employed as a measure of this demand, as is the practice in the waterworks field.

In determining rates for use, in this case represented by $82,770 per year, several blocks could be established, depending on the sewage quantity and quality. In distributing the rates

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among the various blocks the calculations would be made up of two parts. First, the item of $47,100 representing the user's share of the cost of treatment and pumping (usually termed production costs) would be spread uniformly over all users. The amount of $35,670 (or one-half of the fixed charges allocated to use) would, according to the Committee method, be distributed over all of the blocks, with the major portion chargeable to the first block, decreasing progressively in the other blocks. Inasmuch as the details of the assumed system (size and distribution of meters and use) are not available, the complete distribution of the user's share on this basis is not made herein.

For a complete discussion of the procedures involved in such a distribution the reader is invited to review the Joint Committee Report (3) referred to. The underlying principle involved is that service can be provided at less cost per unit to the large user than to the smaller one, and this principle can be followed in distributing the user's share of the cost.

Determination of Annual Charge to Major Wet Industry

By applying the unit rates previously determined to the quantities applicable to the industry under consideration, the following annual charges result:

Property charge	$500,000 at 2.88 mills	= $ 1,440
Volume charge	274,000 thousand gal. at 2.93¢	= 8,030
Susp. solids charge	7,970 hundred lb. at $0.89	= 7,100
B.O.D. charge	15,940 hundred lb. at $1.30	= 20,700
Total		$37,270

Under the Joint Committee method, therefore, this industry which has 2.5 per cent of the total valuation of the community and contributes 20.0, 21.8, and 41.2 per cent of the total volume, the suspended solids, and the B.O.D. loads, respectively, pays 20.6 per cent of the needed total annual revenue of the works.

Comparison of Methods as Applied to the Major Wet Industry

It is interesting to compare the charges which might be assessed against the industry involved in the illustrative example under several of the methods now in use.

Method 1—All charges on general property tax.

$$\$180{,}500 \times \left(\frac{500{,}000}{20{,}000{,}000}, \text{ or } 2.5\%\right) = \$4{,}520$$

Method 2—All charges based on sewage volume (uniform rate).

$$\$180{,}500 \times \left(\frac{274{,}000{,}000}{1{,}370{,}000{,}000}, \text{ or } 20.0\%\right) = \$36{,}100$$

Method 3—All charges based on B.O.D. contribution.

$$\$180{,}500 \times \left(\frac{1{,}594{,}000}{3{,}874{,}000}, \text{ or } 41.2\%\right) = \$74{,}500$$

Method 4—Incremental method. Difference in cost of works to handle all sewage and wastes (including industrial wastes) and the cost of work to handle only domestic sewage. These costs have been estimated approximately as follows:

	Total Incl. Industry	Total Excl. Industry
Construction cost	$2,200,000	$1,852,000
Fixed charges, at 5%	110,000	92,500
Oper. and maint. costs	70,500	63,100
Total annual charges	180,500	155,600
Chargeable to industry	$24,900	

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Method 5—Fixed charges on property by taxation; operation and maintenance on volume (uniform rate):

Fixed charges	$110,000
Oper. and maint. costs	$ 70,500
Fixed charges	$110,000 × 2.5% = $ 2,750
Oper. and maint. costs	$ 70,500 × 20% = 14,100
Total	$16,850

A variation of more than 1,600 per cent is observable between the lowest annual charge ($4,510 on property tax) and the highest ($74,500 on B.O.D. contribution). Also, it should be pointed out that the apparent equality of the charges for Method 2 (volume basis) and the Joint Committee method is a coincidence only (because of the assumption made as to volume and strength for this particular industry). As will be seen later, there is no correlation between the volume basis and the Joint Committee method for other types of users and property.

Comparison of Methods of Apportioning on Different Users and Property

The calculations heretofore indicate the effect of different methods of apportionment compared to the Joint Committee method for one particular class of user and property. Because the aim is to secure fairness to all classes, it is essential to ascertain how the different methods affect the usual question of "who pays the bill." Calculations have been made for three other classes of users and properties as follows:

1. A residence having an assessed valuation of $5,000, with an annual use of 108,000 gal. of water, equivalent to 75 g.c.p.d. based on four persons to the family. The B.O.D. load is assumed at 180 lb. per year and the suspended solids load at 225 lb. per year.
2. The major wet industry already described.
3. A major dry industry having the same assessed valuation as the major wet industry ($500,000), but contributing 1,830,000 gal. per year having a B.O.D. load of 1,830 lb. (at 120 p.p.m.) and a suspended solids load of 2,190 lb. (at 145 p.p.m.) annually.
4. A small wet industry having an assessed valuation of $80,000, an annual sewage volume of 36,500,000 gal., an annual B.O.D. load of 304,000 lb. (at 1,000 p.p.m.), and an annual suspended solids load of 253,000 lb. (at 800 p.p.m.)

The results of the calculations by the different methods are shown in Table IV and Figure 4. The wide difference in the charges to various classes of property by the different methods is apparent. Considering first the residential property, the very high charges based on Method 1 (property tax for all charges) are observable. Although somewhat reduced, Methods 2, 4, and 5 result in high charges to the residential user and property. The major dry industry, on the other hand, pays as much as the wet industry if all charges are apportioned on a property valuation basis. It proportionately pays a very small amount if costs are apportioned in accordance with Methods 2, 3, or 4. The small wet industry pays only a small fraction of its fair share of the costs on a general tax basis. On a B.O.D. basis (Method 3) it pays proportionately too great a share of the annual costs.

In a general way it can be stated that when all revenue requirements are raised by a general property tax, the residential owner, the commercial property, and industrial establishments of the dry type pay more than their fair share of the costs. The charges to residential properties as shown in Fig-

ure 4 indicate that the familiar statement, "It's father who pays the bill," becomes a truism in this case. And he might not be concerned if he was employed in a wet industry, and obtained from it as salary the wherewithall to pay his taxes. But if he happened to be employed in a machine or printing shop, he might very well question the fairness of this method. Distributing all of the costs on the strength of sewage places an unfair

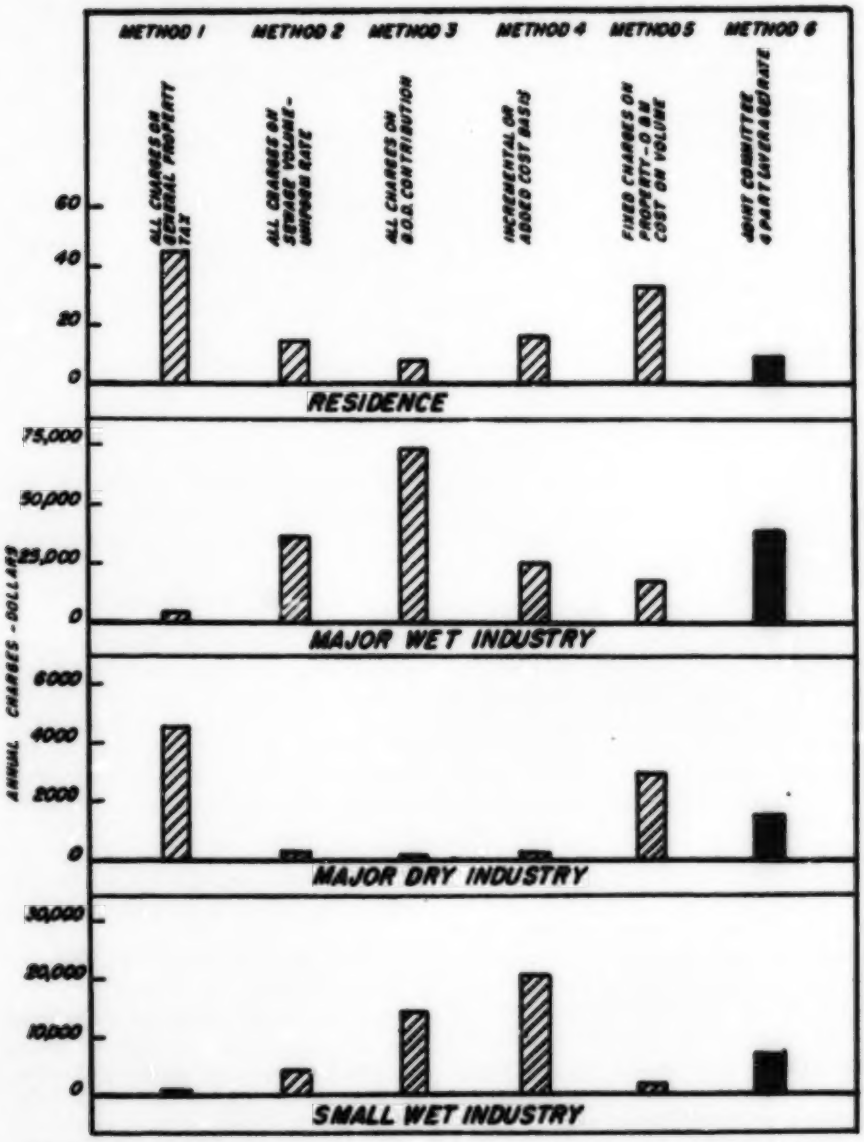

FIGURE 4.—Comparison of various methods of allocating cost on different classes of users and properties.

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TABLE IV.—Comparison of Various Methods of Apportioning Costs on Different Classes of Users and Properties

	Residence	Major Wet Industry	Major Dry Industry	Small Wet Industry
Assessed valuation ($)	5,000	500,000	500,000	80,000
Annual sewage (1,000 gal.)	108	274,000	1,830	36,500
Annual B.O.D. (lb.)	180	1,594,000	1,830	304,000
Annual susp. sol. (lb.)	225	797,000	2,190	253,000
Method 1—all charges on general property tax ($)	45.10	4,510.00	4,510.00	723.00
Method 2—all charges on sewage volume, uniform rate	14.22	36,100.00	241.00	4,820.00
Method 3—all charges on B.O.D. contribution ($)	8.40	74,500.00	85.30	14,200.00
Method 4—incremental method	15.30[1]	24,900.00	260.00[1]	20,700.00[2]
Method 5—fixed charges on prop.; O & M costs on volume	33.06	16,850.00	2,844.00	2,320.00
Method 6—J. C. 4-part rate	8.96	37,270.00	1,536.80	7,510.00

[1] Based on volume.
[2] Based on B.O.D. load.

burden on the wet industries in proportion to the benefits and use received. Most other methods result in unfairness to certain classes of users and property.

As approximately 30 per cent of the capacity of the works is provided for future use, it is desirable to consider the effect of the different methods of charging on undeveloped property. For this purpose an undeveloped parcel is assumed having an assessed valuation of $500. With all charges on property (Method 1) this parcel would pay $4.51 annually. However, with all charges made against users (Method 2—volume basis, and Method 3—B.O.D. basis) it would pay nothing, even though almost one-third of the capacity of the works is provided for later use by undeveloped property. Under the Joint Committee method (if assessed valuation is used as the base) it would pay $1.44 annually. As a matter of fairness it should pay a greater share, as it would if area or front footage served as the basis. This may involve certain complications, because an undeveloped property accessible to an existing sewer receives a greater benefit than does another remote parcel, which may not be serviced for some time in the future.

In summarizing this comparison it will be seen that the Joint Committee method results in charges, which, for different classes of users and property, are in between the extremes of the other methods which have been used. Because of its fairness to all concerned in distributing the cost of pollution abatement, it should be accepted by industry, except perhaps by a minority who may be looking for advantage.

Problems in Applying Joint Committee Method

Lest the reader gain the impression that the employment of this method is extremely simple and that no administrative decisions and technical judgment are involved, it is desirable to point out certain problems, some of a minor and others of a major nature,

which present themselves. Some of these are:

1. A decision on how the distribution of the share of the costs allocated to use should be applied to residential and commercial users must be reached. Because, as suggested by the illustrative example, approximately two-thirds of the use share is to be raised by charges based on constituents (B.O.D. and suspended solids), and because it would be impracticable to measure this contribution, it is necessary to develop a way to raise this share of the funds. It being desirable to have a volume schedule of charges uniform in its application to all, the fraction chargeable to strength could be collected by a surcharge on the basic rate for this class of user. As applied to the illustration, there could be added to the volume rate of 2.93¢ per 1,000 gal. a surcharge of 6.05¢ per 1,000 gal. to account for the constituents in average domestic sewage.

Another approach which has been used is to apply to the volume charge the quality charge for sewage of normal characteristics and to make this the basic quantity charge. For the illustration used, this basic charge would be 8.98¢ per 1,000 gal. Then a special industry would be surcharged or discounted on the quality charge, depending on whether its wastes were stronger or weaker than sewage of normal strength. This procedure may be simpler in application, but both produce the same end result.

2. Inasmuch as sewage characteristics are a factor in the rate schedule under the Joint Committee procedure, as they are in other methods which include composition along with volume, it becomes necessary to measure and analyze the various industrial wastes periodically. This costs money. Neglecting the first cost of the measuring devices, the costs of sampling and analysis may be in the range of $40 to $80 per day of sampling. The frequency of sampling has been variously suggested as biennially, annually, semi-annually, and quarterly, depending somewhat on the size and type of industry. As one considers the small-sized industries the expenses of sampling may be prohibitive. As an illustration, the cost of quarterly sampling for one day each on our small wet industry contributing 100,000 g.p.d. of waste would be approximately $250, which is more than 3 per cent of the income produced in the form of rates. This industry contributes a waste of 1,000 p.p.m. As the waste from another industry of the same volume contribution approaches the strength of normal sewage (200 p.p.m.), the cost of sampling would be about 15 per cent of the income. Or, considering an industry of the same type as the small wet industry, but contributing only 10,000 g.p.d. of wastes, the cost of sampling on the same basis would be more than 30 per cent of the income.

If one considers an average of two days of sampling a year as necessary, and if a top limit of 5 per cent of the income from a user is set as a reasonable cost of sampling, then it might be proper to exclude from such procedure all contributors whose annual bill is less than 120×20, or $2,400. This suggests two reasonable expedients. The first is to place a minimum limit on quantity, below which sampling will not ordinarily be done. Although not for the same purposes, the Chicago Sanitary District proposed such a limit as 10,000 g.p.d. For the purposes of this procedure it would seem that the limit might be higher (except for an unusual waste), or about 50,000 g.p.d.

Another is to set up in the rate ordinance a strength of sewage to be considered as an industrial waste high enough that it would exclude a number of the lesser contributors. Thus, if a top limit of 400 p.p.m. of either suspended solids or B.O.D. (almost twice the strength of the assumed ordinary domestic sewage) were set as the dividing line, a relatively large number of

industries might be excluded from consideration. An objection, of course, is that this procedure would encourage dilution with cooling, or condenser, or other clean waters to escape the strength provisions of the rate schedule. However, by so doing, the industry would be penalized on the quantity portion of the schedule, although in some cases perhaps not in the same proportion.

Obviously, then, the load in pounds of B.O.D. or suspended solids would be the more exact yardstick. If one employs the two limits considered above of 50,000 g.p.d. and 400 p.p.m. of suspended solids or B.O.D., then the annual load limit which might be excluded would be 60,000 lb. Such an industry would contribute (assuming both suspended solids and B.O.D. were at 400 p.p.m.) $1,850 annually on the user's share of the schedule. Sampling for a single day once a year would amount to about 3 per cent of the income from the industry, which might be considered reasonable.

It should be understood that the limiting values considered above are not suggested for use, but are simply illustrative. The illustration does point up the fact that in a rate ordinance reasonable limits should be set on the quantity and quality of wastes which should be considered in this connection. Otherwise, unreasonable expenditures may be involved in sampling and analysis.

3. A problem very frequently presents itself when the collecting system has already been installed and has been paid for on a property basis (either by tax levy, or special assessment, or both) and many years later the need for intercepting sewers and a treatment plant arises. The Joint Committee method includes such sewers in determining the rate base. The amount chargeable to this unit should be segregated and considered separately in determining the allocation of charges. This difficulty is caused by early unfair practice, and should be corrected on a fair basis as far as feasible.

4. It is recognized that municipal sewage systems have a very poor load factor, as variations in quality have somewhat the same pattern as variations in quantity. Certain industries may add to the peak loads, whereas others, either inherently or by controlled storage, may improve the load factor. It is conceivable that the discharge from an industry can be so regulated by storage that it adds nothing appreciably to the designed capacity of the works, and little to the operation costs of certain parts of the plant. In fairness, some adjustment in the rates should be accorded this industry when compared to one which adds its peaks, either normal or abnormal, to those of the balance of the system. Conversely, the industry which adds unreasonably to the peaks should be required to provide storage or should pay a higher rate.

5. It is also recognized that a great number of factors of influencing or controlling importance are involved in these procedures. The Committee report of the California Sewage Works Association (38) discusses some of these. Sometimes the governing body will not feel that it can apply the principles set forth in the Joint Committee method, what with already high property taxes and attempts to broaden the tax base. Nevertheless, the results of the Joint Committee method should be recognized as a point of departure, so that when the practicalities of a local situation influence otherwise, administrative officials will be advised of just how far they are departing from a fair procedure.

6. Although this problem applies equally to other types of rates and rate structures, it should be recognized that, to approach fairness, the allocation and distribution made by the Joint Committee procedures, because they change with time, should be reviewed periodically. Considering just one ele-

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ment of the allocation (for example the provisions for the future), it has already been pointed out that this proportion becomes less as the continued growth of the community approaches the capacity of the works. The frequency of review would depend on the rate of development of the community and its component parts, and intervals of 3 to 10 years have been suggested. However, once the basic facts have been developed this becomes a relatively simple problem.

Use of Formulas for Determining Charges to Industry

In the past five years, more and more references are found in the literature to the use of formulas designed to charge industry for the special service it receives. Where an allocation of costs between users and property is made in advance (as in the case of Buffalo, N. Y.) and a special formula is applied to the user's share which measures the use and benefits, then fairness is possible.

Engineers are inclined to accept a formula as a mathematical expression of facts. Obviously, what may be so for the particular case for which it was derived may be an invalid expression when applied to others. Furthermore, the formula may not be factual at all. The author deprecates the continued advocacy of this type of rate making. Formulas are too easily seized upon by the uninitiated, who, with a false sense of security, apply them with disastrous results, insofar as fairness is concerned.

In an attempt to illustrate this, the author has applied the Wright (27) formula to the example previously considered. Incidentally, this formula has been applied by at least one large city (29)(45)(46) (with some reasonable modifications, however) and one small city (28) which have come to the author's attention. By applying the formula as presented, as one city (28) has done, the charge to the illustrative major wet industry would be $75,300. By modifying it to take into account the differences in strength between the illustration and those which the formulator assumed, the charge to the wet industry becomes $69,300. This compares with charges of approximately $37,000 by the Joint Committee method. It approaches those which the industry would pay on a proportional B.O.D. basis. And considering the method of development, it should be so, because the formula is based on the assumption that all costs of treatment are proportional to the strength of the sewage. Many of them are not, as witness the fact that collection, pumping, and sedimentation costs are based almost wholly on volume and not on strength.

Summary and Conclusions

1. A number of widely varying methods of determining charges for the handling of industrial wastes are employed in United States municipalities.

2. Most of the methods employed place too great a burden on property on the one hand or users on the other and, therefore, result in unfairness to certain classes of properties and users.

3. A sincere desire has been shown by administrators and engineers of municipalities and industries to achieve fairness.

4. The Joint Committee procedure presents a method of achieving fairness in the allocation of costs between users and properties in proportion to the use of, and the benefits received from, the sewage works.

5. Even with the adoption of a method which fairly allocates the costs, a number of factors of influencing or controlling importance must be considered in each local situation.

6. The more general employment of the Joint Committee method, admittedly not as yet adequately tested in all procedural details, will result in improvements in its application.

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CORRECTION

In the paper on "Color in Industrial Wastes. II. Determination by Filterphotometric Method" (THIS JOURNAL, 23, 10, 1291; Oct., 1951), the sentence beginning on page 1295, line 15, should read:

"The total color contribution factors for the Y and Z transmission values were calculated to be, respectively, 0.316 and 0.374."

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